R.O.S.E. By Any Other Name…

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In this talk, we will official unleash a novel, revolutional numerical technique, denoted as Reverse Operation Self-Consistent Evaluation (R.O.S.E.) approach. The R.O.S.E. can be applied in many aspects of numerical computations, such as: the computations of projections on non-conformal meshes without the use of the union mesh, higher order impedance boundary conditions for multi-layer thin coatings, reduced order modeling of the frequency selective surfaces, and the computations of near-singular and hyper-singular integrals inherent in traditional EFIE, MFIE, and CFIE formulations in CEM community.

For many years, the integral equation methods are the popular choice for solving electromagnetic wave radiation and scattering problems. However, the IEs are not without difficulties and compromises. In its raw format, the EFIE involves hyper-singular integrals that are extremely difficult to integrate numerically with satisfactory accuracy. A common remedy is to apply the integration-by-part, or Green's identity, to reduce the hyper-singular kernels to weak singular ones. At the expenses of increasing the smoothness requirements on the trial and test vector functions, hence, the need of the famous RWG div-conformal vector basis functions. Even with the integration-by-part, the IEs still have major technical difficulties to extend to higher order basis functions to enjoy the higher order error convergence rate for smooth solutions. Again, the integration of the self-term, the near field terms, is the main culprit for such a holding-back.

Inspired by the measured equation of invariance (J. M. Rius, R. Pous, and A. Cardama, IEEE Trans. Magnetics, 32, 962-967, 1996), we present in this talk the application of R.O.S.E. to compute the self-term matrix entries in IEs without numerical integrations. Technical details of the application of R.O.S.E. will be outlined during the talk. In short, we firmly believe that the birth of the R.O.S.E. will bring about the Renaissance within the CEM community.